Claims:

1. A process for milling copper adjacent to organic dielectric on a substrate, comprising:
   a. Directing a charged-particle beam at a portion of the copper; and
   b. Exposing the copper to a precursor sufficient to enhance removal of the copper, wherein the precursor contains an oxidizing agent, has a sticking coefficient greater than than about 0.01 and a residence time longer than about 100 ns on the copper, contains atoms of at least one of carbon and silicon in amount sufficient to stop oxidation of the dielectric.
2. The process of claim 1, wherein the precursor contains no atoms of chlorine, bromine or iodine.
3. The process of claim 2, wherein the oxidizing agent comprises at least one of oxygen and nitrogen.
4. The process of claim 1, wherein the oxidizing agent is oxygen.
5. The process of claim 1, wherein the oxidizing agent is nitrogen.
6. The process of claim 1, wherein the oxidizing agent comprises oxygen atoms in an amount no more than about two times the amount of carbon atoms and silicon atoms.
7. The process of claim 1, wherein the oxidizing agent comprises a number of oxidizing-agent atoms, and the atoms of at least one of carbon and silicon is limited to about four times the number of oxidizing-agent atoms.
8. The process of claim 2, wherein the oxidizing agent comprises oxygen atoms in an amount no more than about two times the amount of carbon atoms and silicon atoms.
9. The process of claim 2, wherein the oxidizing agent comprises a number of oxidizing-agent atoms, and the atoms of at least one of carbon and silicon is limited to about four times the number of oxidizing-agent atoms.

10. The process of claim 1, wherein the precursor comprises a compound having a vapor pressure at room temperature between about 0.01 Torr and 1000 Torr

11. The process of claim 1, wherein the precursor comprises a compound which at room temperature provides a pressure in a working chamber of a FIB instrument of less than about $5X10^{-5}$ Torr.

12. The process of claim 1, wherein the precursor comprises a compound which at room temperature provides a pressure in working chamber of a FIB of about 10^{-5} Torr.

13. The process of claim 1, wherein the charged-particle beam comprises an ion beam having an average current density over a scanned area between about 0.01 $pA/\mu m^2$ and about 500 $pA/\mu m^2$.

14. The process of claim 1, wherein the precursor is an insulator precursor.

15. The process of claim 1, wherein the precursor is not a conductor precursor and wherein fragmentation of the precursor results in at least one volatile.

16. The process of claim 1, wherein fragmentation of the precursor produces no electrical conductivity.

17. The process of claim 1, wherein the precursor has a residence time on the copper longer than about 10 μsec on the copper.

18. The process of claim 1, wherein the precursor has a sticking coefficient greater than than about 0.1.

19. The process of claim 1, wherein fragmentation of the precursor results in replacement of a portion of the organic dielectric with another dielectric.

20. The process of claim 1, wherein the copper is continuously exposed to the precursor.

21. The process of claim 20, wherein the charged-particle beam is continuous.

22. The process of claim 20, wherein the charged-particle beam is intermittent.

23. The process of claim 1, wherein the copper is intermittently exposed to the precursor.

24. The process of claim 23, wherein the charged-particle beam is continuous.

25. The process of claim 23, wherein the charged-particle beam is intermittent.

26. The process of claim 1, wherein the precursor has a vapor pressure between about 0.01 Torr and about 1000 Torr in at least a portion of the temperature range between about 0 degrees Celcius and about 100 degrees Celcius.

27. The process of claim 1, wherein the precursor has a vapor pressure between about 0.01 Torr and about 1000 Torr in at least a portion of the temperature range between about 10 degrees Celcius and about 60 degrees Celcius.

28. The process of claim 1, wherein the precursor has a molecular weight between about 2 and about 500.

29. The process of claim 1, wherein the precursor is volatile at temperatures above about 30 degrees Celcius.

30. The process of claim 1, wherein the precursor comprises at least one of the group consisting of NitroEthanol, NitroEthane, NitroPropane, NitroMethane, compounds based on silazane, and compounds based on siloxane.

31. The process of claim 30, wherein the compounds based on silazane include Hexa-Methyl Cyclo-Tri-Silazane.

32. The process of claim 1, wherein the precursor comprises at least one of the group consisting of compounds based on silazane.

33. The process of claim 1, wherein the precursor comprises Hexa-Methyl Cyclo-Tri-Silazane.

34. The process of claim 1, wherein the precursor comprises at least one of the group consisting of compounds based on siloxane.

35. The process of claim 1, wherein the precursor comprises at least one of the group consisting of cyclosiloxane compounds.

36. The process of claim 1, wherein the precursor comprises Octa-Methyl-Cyclo-Tetra-Siloxane.

37. An article having copper adjacent to organic dielectric on a substrate, the copper having a surface treated in accordance with the process of one of claims 1-36.

38. A process of milling copper adjacent to organic dielectric on a substrate, comprising:

    a. Directing a charged-particle beam at a portion of the copper; and

    b. Exposing the copper to a precursor sufficient to enhance removal of the copper, wherein the precursor comprises at least one of the group consisting of NitroEthanol, NitroEthane, NitroPropane, NitroMethane, compounds based on silazane, and compounds based on siloxane.

39. The process of claim 38, wherein the compounds based on silazane include Hexa-Methyl Cyclo-Tri-Silazane.

40. The process of claim 38, wherein the compounds based on siloxane include at least one of the group consisting of cyclosiloxane compounds.

41. The process of claim 38, wherein the precursor comprises a compound having a vapor pressure at room temperature between about 0.01 Torr and about 1000 Torr.

42. The process of claim 38, wherein the charged-particle beam comprises an ion beam having an average current density over scanned area between about 0.01 $pA/\mu m^2$ and about 500 $pA/\mu m^2$.

43. The process of claim 38, wherein the copper is continuously exposed to the precursor.

44. The process of claim 43, wherein the charged-particle beam is continuous.

45. The process of claim 43, wherein the charged-particle beam is intermittent.

46. The process of claim 38, wherein the copper is intermittently exposed to the precursor.

47. The process of claim 46, wherein the charged-particle beam is continuous.

48. The process of claim 46, wherein the charged-particle beam is intermittent.

49. The process of claim 38, wherein the precursor has a vapor pressure between about 0.01 Torr and about 1000 Torr in at least a portion of the temperature range between about 10 degrees Celcius and about 60 degrees Celcius.

50. The process of claim 38, wherein the precursor has a molecular weight between about 2 and about 500.

51. The process of claim 38, wherein the precursor is volatile at temperatures above about 30 degrees Celcius.

52. An article having copper adjacent to organic dielectric on a substrate, the copper having a surface treated in accordance with the process of one of claims 38-51.

53. Apparatus for milling copper adjacent to organic dielectric on a substrate, comprising:

    a. A charged-particle beam source for directing a charged-particle beam at a portion of the copper; and

    b. A precursor source for exposing the copper to a precursor sufficient to enhance removal of the copper, wherein the precursor contains an oxidizing agent, has a sticking coefficient greater than about 0.01 and a residence time longer than about 100 ns on the copper, contains atoms of at least one of carbon and silicon in amount sufficient to stop oxidation of the dielectric

54. The appartus of claim 53, wherein the precursor contains no atoms of chlorine, bromine or iodine.

55. Apparatus for milling copper adjacent to organic dielectric on a substrate, comprising:

    a. A charged-particle beam source for directing a charged-particle beam at a portion of the copper; and

    b. A precursor source for exposing the copper to a precursor sufficient to enhance removal of the copper, wherein the precursor comprises at least

one of the group consisting of NitroEthanol, NitroEthane, NitroPropane, NitroMethane, compounds based on silazane, and compounds based on siloxane.

56. The apparatus of claim 52, wherein the precursor comprises Hexa-Methyl Cyclo-Tri-Silazane.

57. The apparatus of claim 52, wherein the compounds based on siloxane include at least one of the group consisting of cyclosiloxane compounds.

58. The apparatus of claim 54, wherein the precursor comprises Octa-Methyl-Cyclo-Tetra-Siloxane.